On Committees of Experts*

Bauke Visser[†]
Erasmus University Rotterdam
and Tinbergen Institute

Otto H. Swank
Erasmus University Rotterdam
and Tinbergen Institute

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Abstract

We consider a committee that makes a decision on a project on behalf of 'the public'. Members of the committee agree on the a priori value of the project, and hold additional private information about its consequences. They are experts who care both about the value of the project and about being considered well informed. Before voting on the project, members can exchange their private information simultaneously (so no herding). We show that reputational concerns make the a priori unconventional decision more attractive and lead committees to show a united front. These results hold irrespective of whether information can be manipulated or not. Next, we show that reputational concerns induce members to manipulate information and vote strategically if their preferences differ considerably from those of the member casting the decisive vote. Our last result is that the optimal voting rule balances the quality of information exchange and the alignment of interests of the decisive voter with those of the public.

Keywords: Committees, communication, reputational concerns, strategic voting

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[†]Corresponding author. Erasmus University Rotterdam, H 7 – 20, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands. Email: bvisser@few.eur.nl

1 Introduction

Many important decisions are made by committees. The Federal Open Market Committee (FOMC) of the Federal Reserve System and the Governing Council of the European Central Bank decide on monetary policy. Important national policy decisions are made by the Council of Ministers and not by a single minister. Committees also play an important role in parliaments. In the European Parliament, there are 17 committees dealing with internal policies (e.g. the Committee on Budgets or the Committee on Industry, Research and Energy), and three committees dealing with external policies (e.g. the Committee on Development). The health care profession makes extensive use of expert consensus panels. Decisions in business are made by, e.g., management teams, audit committees and boards of governors. Tenure and promotion decisions in, e.g., academia and law firms are typically made by committees.

Compared to individual decision-making, committee decision-making benefits from the possibility of information exchange and discussion before a decision is reached. Potentially, decisions taken by a committee are therefore based on more or better information than decisions taken by a single individual. We use the word "potentially" for two reasons. First, when information is endogenous, committee decision-making suffers from a free-rider problem. As a result, individual committee members may put insufficient effort in acquiring information (see Mukhopadhaya, 2003, and Persico, 2000). The second reason is perhaps less known to economists than the first one, but possibly as important. Students of group decisions have frequently found that members of committees are reluctant to openly express their opinions.[1] In particular, members of groups often feel a pressure to conform.

Concurrence-seeking tendencies may explain instances of committee decision-making resulting in poor performance. Interesting in this respect is the work by Janis (1972), who described several failures in U.S. policy decision-making after the Second World War. Most famous is his analysis of the decision by the Kennedy administration to invade Cuba at the Bay of Pigs. In late 1960, the CIA conceived the plan to place a brigade of Cuban exiles on the coast of Cuba with the ultimate aim of bringing down the government. The group that later approved the plan

[1] See, e.g., Gouran and Hirokawa (1996) and Hirokawa et al (1996).

consisted of President Kennedy, some members of his cabinet, two CIA officials and a number of White House staff. What has surprised students of this case was the fact that the CIA officials were able to paint too rosy a picture of the chances of success, and that this depiction of reality went by and large unquestioned. Although various members of the group had serious reservations about the plan, these were either not aired or were easily challenged by the CIA promoters of the plan. A couple of days after the brigade invaded Cuba, the plan turned out to be a "perfect failure". Janis makes it quite clear that the reason for this failure was not lack of information. The reason was incomplete disclosure of available information.

In this paper we present a model that explains a number of phenomena as the result of committee members' desire to be perceived as able decision–makers. These phenomena include, first, the desire of a committee to show a united front; second, the attractiveness of the a priori unlikely decision; third, the tendency to present manipulated information that favours this decision by some members of the committee; and fourth the acceptance of this risky undertaking in the presence of strong personal doubts by others.

In our model, a committee of experts has to decide on behalf of the public (or an organization) whether to implement a project or to maintain the status quo. The problem is that the consequences of the project are uncertain. Concerning the project, members have common preferences. However, each member has a private view of the consequences of the project. The more likely it is that someone is competent, the more likely it becomes that a member's view provides an accurate picture of the consequence of the project. A member does not know whether he is competent or not, only that he is competent with a certain probability.

A distinguishing feature of our model is that committee members are concerned with the way the decision reached reflects upon their decision-making ability. Because of, e.g., career concerns, peer pressure, or adherence to internalized professional standards, committee members want to be perceived as being competent. The presence of reputational concerns in committees is illustrated by the following quote from Lawrence Roos, a former president of the St. Louis Federal Reserve Bank and member of the FOMC: "If one is a young, career-oriented president who's got a family to feed, he tends to be more moderate in his opposition to governors" (Greider 1988, p. 205). This quote also suggests that committee members may care about their reputation to different extents. For this reason, we allow that some members care more about their reputation than others.

The committee reaches a decision in two stages. In the first stage, the communication stage, each member can share his privately held view with the other members. We assume that members simultaneously reveal their views. This amounts to assuming that speeches are prepared in advance. In the second stage, the voting stage, members casts their votes simultaneously, and votes are aggregated using some voting rule (unanimity or other majority rules).[2] After the committee has arrived at a decision, the 'market', the people whose judgment committee members care about, forms a belief about the competence levels of committee members. We assume that the market does not observe the value of the project, only the decision taken. This assumption lacks realism in some situations, like the ones discussed in Janis (1972), but not in others. Gabel and Shipan (2004, 544), e.g., while on the topic of comparing the quality of expert panel decision–making with individual decision–making in the health care profession, point out that "we would need to know the correct treatment decision before we could empirically evaluate the accuracy and performance of expert panels in prescribing treatments". Such knowledge is typically hard to get: "Indeed, expert panels exist precisely because of the absence of clear empirical guidance" (emphasis in original)

We derive four main results. First, as soon as members care about their reputation, they want to speak with one voice. Disagreement signals lack of competence as competent members view the consequences of the project in the same way. Both the proponents and the opponents of the final decision have an interest in forming a unified front once the decision has been taken. Schultz, a former Governor and Vice-Chairman of the FOMC states it succinctly: "We should argue in the Board meetings but close ranks in public" (Greider 1988, p. 390). Our first result is consistent with the observation made by Chappell et al (2003) that disagreements within the FOMC do not show up in voting records. Illustrative is their finding that the number of dissenting votes on policy directives is rather small, only 8% of all votes in the period 1966-1996.[3]

[2]We therefore exclude any discussion of the well-known phenomenon of herding. Our findings show that reputational concerns matter even if members of a group take decisions simultaneously.

[3]Sometimes, members publicly state their disagreement. We provide various explanations in Section 8.

Our second result is that reputational concerns may distort the project implementation decision. The reason for this result is that the eventual decision on the project affects members' reputations, and that therefore one decision is more attractive than another from a reputational perspective. To understand why, suppose that it is socially optimal to implement the project only if all committee members privately hold the view that the project is good. With such a decision rule, implementation of the project implies that the members' views concur. This is good for the committee members' reputations. However, as status quo may be the result of disagreement among the committee members, maintaining the status quo damages the members' reputations. Hence, in this situation, reputational concerns give incentives to the committee members to choose implementation even when maintaining status quo would be socially optimal. The stronger is the desire to come across as a competent decision-maker, the stronger is the incentive to distort the implementation decision.

Third, as members differ in the extent to which they care about their reputations, some members may see their attempts to influence the implementation decision in the voting stage frustrated. This may keep them from revealing private information truthfully in the communication stage. Suppose, for example, that implementation of the project boosts the committee members' reputations. Then, reputational concerns give incentives to committee members to paint too rosy a picture of the project and to exaggerate its benefits. Committee members may even become completely uncritical in which event their statements will be ignored. We show that the members who are most concerned with their reputations have the strongest incentives to downplay negative information and present positive information instead. This result reminds us of the decision on the Cuban invasion plan. In the advisory committee on this plan, the two CIA officials were especially active advocates of the plan. In the light of our model this is hardly surprising. As these members had been involved in developing the project, their reputations were particularly at stake. The other members of the committee were less committed to the CIA plan. However, since the group was quite new - President Kennedy had only been in office for a couple of months - members may well have considered the effect of their behaviour on the way they were viewed by other members, in particular President Kennedy. For example, Janis found that suppressing of personal doubts was the rule in the Committee on the Cuban invasion plan. Illustrative of his finding is the following quote "in his account of the Bay of Pigs fiasco, Schlesinger admits that he hesitated to bring up his objections while attending the White House meetings for fear that others would regard it is presumptuous for him, a college professor, to take issue with august heads of major government institutions." (Janis, 1972, p. 32).

The final result deals with the influence the voting rule has on the implementation decision. In case information cannot be manipulated, to protect the public from the negative consequence of reputational concerns, one should make the person who is the least interested in his reputation decisive. This can be guaranteed by imposing unanimity rule. In case information can be manipulated the choice of voting rule should balance the benefits from information exchange between members before votes are cast and the costs of making a member decisive whose interests are less aligned with those of the organization than the interests of some other member. In the absence of reputational concerns, the voting rule would be immaterial. In that case, no one is willing to sacrifice project payoff for a strengthened reputation. Hence, once all private information has been shared, all members agree on the decision on the project (see Coughlan, 2000, and Gerardi and Yariv, 2003).

The plan of the paper is as follows. The next section discusses related literature. Section 3 presents a two persons version of our model. In Sections 4–6, we analyze this model. In Section 7 we show how our results extend to committees consisting of more than two persons. Section 8 concludes.

2 Related Literature

This paper contributes to the literature on committee decision-making. Gerling et al (2004) provide a recent survey of this literature. In this section, we do not repeat their work. Instead, we discuss a limited number of studies in order to illuminate how our main findings are related to previous results.

Quite a few studies deal with committee decision making as trial by a jury. Decision makers (jurors) have private information about the state of nature (whether the accussed person is guilty or innocent), and have to make a decision (convict or acquit the defendant). Their goal is to avoid making the wrong decision (convicting the innocent or acquiting the guilty). The decision is reached using some voting rule. Concerning the optimal organization of the jury, two questions are frequently addressed. First, what is the optimal size of the jury (e.g., Mukhopadhaya, 2003 and Persico, 2004)? Second, what is the optimal voting rule (e.g., Feddersen and Pesendorfer 1998, Ladha, 1992 and Young, 1988)?

Our model differs from the above models in two important respects. First, we assume that communication among decision makers is possible before votes are cast. Coughlan (2000) was one of the first who showed the importance of communication. His model extends the Feddersen and Pesendorfer model to allow for limited communication among jurors. In particular, he assumes that the jury takes a non–binding preliminary vote before taking the final binding vote. Coughlin shows that an equilibrium exists in which each juror reveals his signal in the straw vote. The implication is that in the final vote, jurors have no incentives to vote strategically. More generally, Gerardi and Yariv (2003) argue that communication among jurors with identical preferences renders voting rules equivalent. When information is shared, either all jurors agree that the defendant is guilty or agree that the defendant is not guilty. The results derived by Feddersen and Pesendorfer that unanimous jury verdicts leads to strategic voting and implies a higher probability of convicting the innocent than simple majority rule therefore rest on the assumption that jurors cannot share information.

The second difference is that we model decision makers as experts who care about their perceived decision–making ability. This assumption is plausible when committee members are selected because of their expertise as is typically the case for the committees mentioned in the introduction. Jurors are not a good example. They are usually laymen whose professional reputations do not depend on how well they are perceived as jurors.[4]

The result obtained by Gerardi and Yariv also applies to our model: if members of the committee care to the same degree about their reputation, information can be shared and the voting rule is immaterial. Li et al. (2001) show that conflicts of interest limit the possibility of communication (see also Beniers and Swank, 2004). In fact, Li et al. argue that conflicts of interest provide a rationale for the existence of a voting procedure. When committee members are concerned with their reputation to

[4]Ottaviani and Sorensen (2001) also model committee members as decision makers who care about their reputation. In their model, members state their opinion publicly in turn.

various degrees, reputational concerns may lead to conflicts of interest. Our finding that reputational concerns may lead to manipulation of information and renders the voting rule important is in line with Li et al. Our analysis in section 7 shows how the choice of voting rule, by identifying the member whose vote is decisive, influences the extent of information exchange in the communication stage.

As emphasized before, in our model committee members are concerned with their reputation. Reputational concerns play an important role in the herding literature (see Scharfstein and Stein, 1990, for one of the seminal contributions, and Ottaviani and Sorensen (2001) for an application to committee decision making). A distinguishing feature of the herding literature is the sequential nature of decisions and the manipulability of private information. Herding exists if the second player in order mimics the first player by claiming he holds the same private information as revealed by the first player's decision. The incentive to mimic stems from the fact that the second player does not want to let the public know that he disagrees with the first player. Our model deviates from the herding literature in that agents act simultaneously rather than sequentially. Accordingly, mimicking cannot take place. Moreover, in our model it may be the case that information cannot be manipulated. This does not mean that reputational concerns do not play a role. As some decisions require more concurrence than other decisions, some decisions are better for the agents' reputations than other decisions. Reputational concerns increase the likelihood that committee members choose the unconventional, i.e., the a priori unlikely decision. [5]

There is a related literature about the desirability of transparency in committee decision making. One argument for transparency is that it enables the public to judge whether officials are acting in its interest (see for example Gersbach and Hahn, 2004). We do not intend to contribute to this literature in the present paper, other than by observing that transparency may strengthen committee members' incentives to shy away from showing differences in opinion (see also Meade and Stasavage, 2004).

[5] Milbourn et al. (2001) and Suurmond et al. (2004) analyse how reputational concerns influence the implementation decision in a single agent setting.

3 The Model

On behalf of the public (or an organization), a committee of two members, 1 and 2, must make a decision whether to implement a project, denoted $X = 1$, or to maintain the status quo, denoted $X = 0$. By normalization, status quo delivers a payoff equal to zero. If implemented, the project yields a payoff to each member (and the public) equal to $p + \mu$. The parameter p is the expected payoff of the project. The stochastic term μ captures that the consequences of the project are uncertain. We assume that $\mu \in \{-u, u\}$, with equal prior probability. Moreover, we assume that (i) $p < 0$, implying that without further information about μ the status quo should be maintained; (ii) $p + u > 0$, implying that the proper decision on the project depends on value of the stochastic term.

At the beginning of the game, each member possesses a private signal about μ, $s_i \in S_i = \left\{s^b, s^g\right\}$, $i = 1, 2$. A signal refers to a member's assessment of μ (b is bad and g is good). Whether this signal is informative depends on a member's type, t_i. Each member can be smart or dumb, $t_i \in \{sm, du\}$. The prior probability that a member is smart equals π. A smart member has a fully informative signal about μ. His opinion of μ is flawless, $\Pr(\mu = u \mid s^g, sm) = \Pr\left(\mu = -u \mid s^b, sm\right) = 1$. A dumb member receives an uninformative signal: $\Pr(\mu = u \mid s^g, du) = \Pr\left(\mu = u \mid s^b, du\right) = \frac{1}{2}$. He does not learn anything new about the expected value of the project. A member does not know his own competence, only the probability with which he is smart, π. The *ex ante* probabilities of μ, and the prior probability π are common knowledge.

The decision on the project is made in two stages. In the first stage, the communication stage, member $i = \{1, 2\}$ sends a message, $m_i \in M_i = \left\{m^b, m^g\right\}$. By this we mean that a member presents an analysis of μ. This may or may not reflect his true assessment. In the second stage, the voting stage, the messages sent are common knowledge, and the members vote on the project, $v_i \in \left\{v^b, v^g\right\}$, where $v_i = v^b$ ($v_i = v^g$) denotes that i votes against (for) the project. The relationship between the individual votes cast and the decision on the project is determined by the voting rule. We start our analysis by assuming that implementation of the project requires that both members vote for the project, $v_1 = v_2 = v^g$. In section 6, we show that the assumption $p < 0$ implies that unanimity is the socially optimal voting rule in case of two members.

We assume that messages are sent simultaneously, and that votes are cast simultaneously. We make this assumption for two reasons. First, in some committees the statements presented are typically prepared before the meeting takes place. For example, governors, directors, and FED staff come to the FOMC meeting with their analyses prepared. Second, by excluding sequential decision making in either stage we can avoid a discussion of the well-known phenomenon of herding. Our analysis shows that reputational concerns may lead to socially undesirable outcomes even in the absence of sequential decision making.

Apart from project payoffs, a member is concerned with his perceived level of competence. We refer to this as his reputation. It is defined as the belief the 'market' holds that a member is smart once a decision on the project has been made. We assume that when forming its beliefs, the 'market' does not observe μ. Specifically, member i's preferences are represented by

$$\begin{aligned} U_i (X = 1) &= p + \mu + \lambda_i \widehat{\pi} (X = 1) \\ U_i (X = 0) &= \lambda_i \widehat{\pi} (X = 0) \end{aligned} \tag{1}$$

where λ_i denotes the relative weight member i attributes to his reputation, and $\widehat{\pi} (X = x) = \Pr (t_i = sm | X = x)$ is the posterior probability that member i is smart, conditional on the decision on $X = x$. Committee members have homogenous preferences as to the project, but differ in the weight they give to their reputation, $\lambda_1 < \lambda_2$. These weights are common knowledge.

We make an assumption to ensure that in expected terms, and in the absence of reputational concerns, committee decision making yields better decisions than decision making by a single individual. In particular, we assume that if one member has received a positive signal, then the optimal decision on the project depends on the signal received by the other member. As members are equally smart, one positive and one negative signal cancel each other out, $p + \mathsf{E} \left(\mu \mid s_1 = s^g, s_2 = s^b \right) = p$. As $p < 0$, the project should be rejected. Therefore, to ensure that committee decision–making improves upon individual decision–making we assume $p + \mathsf{E} (\mu \mid s_1 = s^g, s_2 = s^g) > 0$.

Assumption 1 *In the absence of reputational concerns, committee decision making* *yields better decisions than individual decision making,* $p + \mathsf{E}(\mu \mid s_1 = s^g, s_2 = s^g) > 0$.

This assumption implies that from the organization's point of view, the project should be implemented if and only if both members receive a positive signal. We refer to a situation in which the committee chooses $X = 1$ if and only if the signal set equals $(s_1, s_2) = (s^g, s^g)$ as a situation in which a first-best decision rule is followed. Notice that we use (1) with $\lambda_i = 0$ as the public's payoff function.

We conclude this section with a note on equilibria. As the messages sent become common knowledge before members vote, we use subgame perfection. As is common in voting games, if $X = 1$ requires a majority of favourable votes, it is always an equilibrium for all members to vote against implementation, independent of the signals received and the messages sent. We ignore such equilibria. Moreover, we assume that if a member decides to reveal his private information he uses a natural language (m^g if s^g, and m^b if s^b), rather than the inverted language. We also ignore babbling equilibria if information can be manipulated, and focus instead on equilibria in which as much information is exchanged given the interests of the members.

4 Information cannot be manipulated

We begin by analysing the case in which a member is only able to truthfully reveal his private signal. This means that a member is unable either to paint too rosy a picture of the circumstances determining the project's value or to intentionally understate the project's likely benefits. We start our analysis in this way for two reasons. First, it may be a realistic case. The impossibility of manipulating information may result from the fact that other members ask pertinent and probing questions. As these members are experts, claims will be verifiable at least to some extent, in the sense that a member cannot claim everything. The underlying idea is that, as in Dewatripont and Tirole (2004), (investment in) communication may make information hard. The other reason to start the analysis by assuming that information is truthfully revealed is that the ensuing analysis suggests which member has an incentive to manipulate information and in which situation.

4.1 Equilibrium

We begin by identifying the conditions under which the first-best decision rule is an equilibrium outcome of the game. We next characterize the equilibrium outcome in case this decision rule is not an equilibrium outcome. Initially, we assume that members speak with one voice, meaning that the public cannot infer any information about the quality of the members from their public statements regarding their privately held views or the votes cast. The public can therefore only infer information from the decision on the project. In Section 6.1, we show that committee members who care about their reputation want to speak with one voice.

If members vote favourably only if $(s_1, s_2) = (s^g, s^g)$, the first-best decision is the equilibrium outcome, and posterior beliefs are:[6]

$$\begin{aligned} \widehat{\pi}\,(X=1) &= \frac{1+\pi}{1+\pi^2}\pi > \pi \\ \widehat{\pi}\,(X=0) &= \frac{3-\pi}{3-\pi^2}\pi < \pi \end{aligned} \tag{2}$$

If the first-best decision rule is followed, implementation yields a higher reputation than maintaining the status quo. The reason is that with this decision rule, the public can infer from implementation that both members have received the same (positive) signal, whereas the decision to maintain the status quo may have resulted from either two concurring (negative) signals, or from two conflicting ones. As smart members receive identical signals, conflicting signals are a unequivocal sign that at least one member is dumb.

As signals are not manipulated, we only have to determine which votes are cast for given signal sets. Suppose that both members have presented positive information, $s_1 = s_2 = s^g$, and suppose the public holds the posterior beliefs given in (2). Then, both members prefer implementation to maintaining the status quo, $v_i = v^g$, $i = 1, 2$, because the expected project payoff is positive by assumption 1 and because implementation strengthens their reputations.

If instead one or both of the signals is negative, implementation would be bad from a project point of view but beneficial from a reputational point of view. This suggests that with strong enough reputational concerns, the first-best decision rule

[6] The derivation can be found in the proof of proposition 1.

is not an equilibrium outcome of our game. Because implementation requires that both members vote favourably, both members have to be willing to cast a favourable vote for a deviation from the first-best decision rule to occur. Obviously, member 1, who cares less about his reputation than member 2, is less inclined to sacrifice project payoff for a strengthened reputation. If he is willing to implement the project for a given signal set, then so is member 2. This implies that member 1 is decisive.

If member 1 is not inclined to vote favourably in case of one negative signal, then he will certainly refrain from casting a favourable vote in case of two negative signals—the expected project loss would be even larger, whereas the gain in reputation would be left unaffected. The next proposition states the maximum degree to which member 1 may care about his reputation such that the committee uses the first-best decision rule.

Proposition 1 *Suppose that members do not manipulate information, and that the voting rule is unanimity. Then the first-best decision rule (implement if and only if* $s_1 = s_2 = s^g$*) is an equilibrium outcome if and only if*

$$\lambda_1 \leq \overline{\lambda} := \frac{-p}{\widehat{\pi}\,(X=1) - \widehat{\pi}\,(X=0)}$$

If the first-best decision rule is not an equilibrium outcome, what is the equilibrium outcome? It is easy to verify that implementing the project if the signal set is $(s_1, s_2) = \left\{(s^g, s^g), \left(s^b, s^g\right), \left(s^g, s^b\right)\right\}$ cannot be an equilibrium outcome. Such a decision rule would imply a larger degree of signal concurrence in case of rejection than in case of implementation, and therefore that $\widehat{\pi}\,(X=0) > \widehat{\pi}\,(X=1)$. With such posterior beliefs, either member would vote against the project when the signals are conflicting. This suggests that an equilibrium in mixed strategies exists such that, in case of conflicting signals, the committee sometimes does and sometimes does not implement the project. Suppose that member 1 votes favourably if both signals are positive; votes favourably with probability β_1 in case of conflicting signals, $s_1 \neq s_2$; and votes against if both signals are negative. As member 1 is indifferent when he mixes, member 2, who cares more about his reputation, must have a strict preference for voting favourably. Moreover, if member 1 is against implementation, member 2 may still favour implementation. Unanimity, however, guarantees that member 1's vote is decisive. A weakly dominant strategy for member 2 is therefore to vote favourably unless both signals are negative.[7]

With the postulated members' strategies, the posterior probabilities are[8]

$$\begin{aligned} \widehat{\pi}(X=1;\beta_1) &= \frac{(1+\pi)+2(1-\pi)\beta_1}{(1+\pi^2)+(1-\pi^2)\beta_1}\pi \\ \widehat{\pi}(X=0;\beta_1) &= \frac{3-\pi-2(1-\pi)\beta_1}{3-\pi^2-2(1-\pi^2)\beta_1}\pi \end{aligned} \tag{3}$$

As member 1 mixes in case of two conflicting signals, he is indifferent between implementation and maintaining the status quo, implying that β_1 is determined by:

$$p+\lambda_1\widehat{\pi}(X=1;\beta_1)=\lambda_1\widehat{\pi}(X=0;\beta_1) \tag{4}$$

With $p<0$, we have that $\widehat{\pi}(X=1;\beta_1)>\widehat{\pi}(X=0;\beta_1)$ in equilibrium. This implies that the probability with which member 1 votes favourably (and hence the probability with which the project is implemented) is smaller than a half. Implementation still requires a higher degree of agreement among signals than rejection, and so $\beta_1<\frac{1}{2}$.

Proposition 2 *Suppose that members do not manipulate information, and that the voting rule is unanimity. For $\lambda_1>\overline{\lambda}$, the committee chooses*

$$\begin{array}{cc} X=1 & \text{if } s_1=s_2=s^g \\ X=1 \text{ with probability } \beta_1^* & \text{if } s_1\neq s_2 \\ X=0 & \text{if } s_1=s_2=s^b \end{array}$$

where β_1^* solves $p+\lambda_1\widehat{\pi}(X=1;\beta_1)=\lambda_1\widehat{\pi}(X=0;\beta_1)$ and satisfies $\beta_1^*<\frac{1}{2}$. Member 1's strategy is to vote $v_1=v^g$ if $s_1=s_2=s^g$; $v_1=v^g$ with probability β_1^* in case of $s_1\neq s_2$; and $v_1=v^b$ if $s_1=s_2=s^b$. Member 2's strategy is $v_2=v^g$ unless $s_1=s_2=s^b$.

We would like to stress three features of this equilibrium. First, it implies that the member who cares the least about his reputation, member 1, is decisive. The role of member 2 is limited to providing information. Second, the frequency with which the

[7] Another strategy for agent 2 would be to vote favourably irrespective of the signals.
[8] For the derivation, see the proof of Proposition 2.

implementation decision is distorted is increasing in the weight member 1 attaches to his reputation; member 2's reputational concern is immaterial. Finally, the less biased the members are towards the project, i.e., the closer p is to zero, the more frequent the committee distorts the implementation decision as the costs of voting favourably in case of conflicting signals go down.

5 Information may be manipulated

In the previous section, we have seen that member 2 may be frustrated in his attempt to implement the project. Member 1 is less inclined to vote favourably, and as a consequence member 2's role is reduced to providing information. In this section, we analyse how member 2 can exploit his role of information provider to further his own interests. We therefore now assume that information can be manipulated. This means that at least a shadow of doubt may remain about the veracity of a member's statement even after the deliberations have taken place in the communication stage.

Thus, behaviour of member i in the communication stage is characterized by a communication strategy $m_i(s_i) = \Pr(m_i = m^g | s_i)$ for $s_i \in \{s^b, s^g\}$. Three types of communication strategies play an important role. *Information sharing* means that private information is revealed, $m_i(s^g) = 1$ and $m_i(s^b) = 0$. *Exaggeration* refers to a strategy in which too rosy a picture is painted, $m_i(s^g) = 1$ and $m_i(s^b) > 0$. *Underreporting*, finally, refers to a strategy in which positive information is manipulated, $m_i(s^g) < 1$ and $m_i(s^b) = 0$. The latter strategy can be ignored in this section given the interests of the members and because of unanimity.

In the previous section we have shown that if both members care little about their reputation, $\lambda_i \leq \overline{\lambda}$, neither member has an incentive to deviate from the first-best decision rule as neither is willing to accept a bad project in return for a better reputation. For $\lambda_2 > \overline{\lambda} > \lambda_1$, and for given posterior probabilities (2), member 2 would like to implement the project in case of $s_1 \neq s_2$, whereas member 1 votes against. Anticipating member 1's behaviour, and knowing that member 1 will vote favourably when both messages are positive, member 2 may exaggerate the benefits of the project (report $m_2 = m^g$ while $s_2 = s^b$) in an attempt to make member 1 cast a vote for implementation. Given member 1's voting behaviour, always exaggerating the benefits of the project cannot be part of an equilibrium strategy of member 2:

as member 2's message would be devoid of content, the decision to implement or to reject would depend solely on the view held by member 1. No comparison of signals received by members 1 and 2 would be possible. As a result, either decision would lead to the same reputation, $\widehat{\pi}(X=1) = \widehat{\pi}(X=0) = \pi$. Member 2 will therefore exaggerate with a probability $\gamma_2 := m_2\left(s^b\right) < 1$. Clearly, member 1 takes into account member 2's inclination to exaggerate. He will therefore only vote favourably in case $(s_1, m_2) = (s^g, m^g)$ if

$$p + \mathsf{E}(\mu \mid s_1 = s^g, m_2 = m^g) + \lambda_1 \widehat{\pi}(X = 1; \gamma_2) > \lambda_1 \widehat{\pi}(X = 0; \gamma_2) \tag{5}$$

With $\gamma_2 = 0$, (5) was assumed to hold, see assumption 1. The more frequent member 2 exaggerates, the less information the message $m_2 = m^g$ contains, and the lower is $\mathsf{E}(\mu \mid s_1 = s^g, m_2 = m^g)$. Possibly, γ_2 is that high that member 1 prefers maintaining the status quo to implementing the project.

If member 2 exaggerates with probability γ_2, this means that, conditional on $s_2 = s^b$, he is indifferent between telling the truth and exaggeration when the message he sends is pivotal. His message is pivotal only if $s_1 = s^g$, and so γ_2 satisfies $p + \mathsf{E}\left(\mu \mid s_1 = s^g, s_2 = s^b\right) + \lambda_2 \widehat{\pi}(X = 1; \gamma_2) = \lambda_2 \widehat{\pi}(X = 0; \gamma_2)$ or

$$p + \lambda_2 \widehat{\pi}(X = 1; \gamma_2) = \lambda_2 \widehat{\pi}(X = 0; \gamma_2) \tag{6}$$

The more member 2 cares about his reputation, and the smaller the expected loss incurred in case of implementation on the basis of conflicting information, the more likely it becomes that he paints too rosy a picture. In particular, if $\lambda_2 \to \infty$, then in equilibrium $\gamma_2 \to 1$, provided (5) holds. This condition holds if member 1 is willing to follow his signal if he were to decide in isolation, (i.e., $X = 1$ if and only if $s_1 = s^g$, which requires $p + \pi u > 0$).

If member 1 also cares considerably about his reputation, $\lambda_2 > \lambda_1 > \overline{\lambda}$, he is more willing to accept exaggeration by member 2: a larger value of λ_1 makes condition (5) hold for a larger parameter set. However, what does not change is the information on the basis of which he votes for implementation: $v_1 = v^g$ if and only if $(s_1, m_2) = (s^g, m^g)$. To understand why, consider the remaining possibilities (s_1, m_2), which, in increasing order of implied expected project loss, are $\left(s^g, m^b\right)$, $\left(s^b, m^g\right)$, or $\left(s^b, m^b\right)$. Now take $(s_1, m_2) = \left(s^g, m^b\right)$, which must mean that $s_2 = s^b$.

For $s_2 = s^b$, member 2 is indifferent between $X = 1$ and $X = 0$. As member 1 cares less about his reputation than member 2, he must have a strict preference for $X = 0$ if $(s_1, m_2) = \left(s^g, m^b\right)$, so $v_1 = v^b$. Hence, also $v_1 = v^b$ in case of $(s_1, m_2) = \left\{\left(s^b, m^g\right), \left(s^b, m^b\right)\right\}$.

Proposition 3 *Suppose information can be manipulated, and suppose $\lambda_2 > \overline{\lambda}$. Let $\gamma_2 = \gamma_2^*$ solve Equation (6). If (a) $p + \pi u > 0$, an equilibrium exists in which (i) the committee chooses $X = 1$ if and only if $m_1 = m_2 = m^g$; (ii) member 1 shares his information, and votes $v_1 = v^g$ if and only if $m_1 = m_2 = m^g$; (iii) member 2 exaggerates with probability γ_2^* if $s_2 = s^b$, and votes $v_2 = v^g$ if and only if $m_1 = m_2 = m^g$; If instead (b) $p + \pi u \leq 0$, then the equilibrium is as described under (a) if (5) is satisfied for $\gamma_2 = \gamma_2^*$; otherwise member 1 always votes against implementation.*

A comparison between Proposition 2 and Proposition 3 shows that there are two implications of relaxing the assumption that information cannot be manipulated. First, when information may be manipulated, member 2 rather than member 1 determines the extent to which the implementation decision is distorted. Second, the inclination to manipulate may be so strong that the information provided in the communication stage becomes too unreliable as a foundation for the decision to implement the project.

6 The optimal voting rule

So far we have assumed the committee uses a voting rule which stipulates that implementation requires two favourable votes. We now show that this rule is desirable from a public point of view, both when information cannot and when it can be manipulated.

Suppose that information cannot be manipulated. Unanimity rule makes the member who cares the least about his reputation decisive. A deviation from the first-best decision rule only occurs if he cares considerably about his reputation, $\lambda_1 > \overline{\lambda}$. Had the formal decision rule required merely one positive vote for implementation, the member who cares most about his reputation would have become decisive. A deviation from the first–best decision rule would have occured as soon as $\lambda_2 > \overline{\lambda}$.

Moreover, as $\lambda_2 > \lambda_1$, the deviation from the first–best decision rule would have been larger. By imposing unanimity, the vote of the member whose preferences resemble those of the public most, the public's ally, is decisive in case of a conflict among the members of the committee. Clearly, this result also holds in case of more than 2 members.

In case information can be manipulated, it can be shown that the voting rule is immaterial. As this finding is specific to the two–member committee and does not generally extend to n–member committees we have relegated its derivation to the appendix.

Proposition 4 *Suppose a committee of two members. If information cannot be manipulated, unanimity is the voting rule that best aligns the interests of committee members and society. If information can be manipulated, unanimity and majority perform equally well.*

That unanimity performs so well from the public's perspective is thanks to the fact that differences among committee members are limited to one dimension – the degree to which they care about their reputations. Had they disagreed also on the a priori value of the project, p, unanimity would probably have stymied decision making as the most conservative member, the one with the lowest a priori expectation, would play a very important role. Indeed, if members were to care to the same extent about their reputations, the most conservative member would become decisive. Only if the public were equally conservative this would be beneficial.

If members were to care to the same degree about their reputations, the formal decision rule would be immaterial. All information would be truthfully revealed, even if it could be manipulated, and members would agree as to the best decision on the project. Delegating the decision to one member or requiring unanimity would not affect the final decision taken. Of course, if neither member were to care about his reputation, this decision would coincide with the socially desirable one. The following proposition, which is a variant of a result in Coughlan (2000) and Gerardi and Yariv (2003), summarises.

Proposition 5 *Suppose committee members care to the same degree about their reputation. Then, the voting rule does not influence the decision taken by the committee.*

6.1 The desire to speak with one voice

We have assumed that the market can base the members' ex post reputations only on the implementation decision, X. In particular, it does not observe the true state μ, nor has it got access to the voting record or to a transcript of the meeting. The committee members may not be able to make μ observable. However, they may decide to publish the voting record or a transcript of the meeting or they could organize a press conference after the meeting. We now show that committee members who care about their reputations will show a united front and speak with one voice both concerning the votes they cast and the views they presented in the meeting.

Suppose the committee members would truthfully report the views (m_1, m_2) they exchanged during the meeting. These views, and not the decision taken on the project, would then determine the market's impression of a member's decision-making competence. Suppose that information was shared in the meeting. It is easy to verify that $\widehat{\pi}(s_1 = s_2) > \pi > \widehat{\pi}(s_1 \neq s_2)$ in case of truthful reporting: as smart members receive identical signals, opposing signals are a clear indication that at least one member is dumb. This means that once a decision has been taken by the committee both members have an interest in deviating from truthful revelation and in showing a united front. In case of implementation they will claim that both of them possessed favourable information, while if the project is rejected they will underline that both of them regarded the project as undesirable. Thus, statements about the views exchanged cannot form a useful basis for forming a belief about the competence of a committee member. As a result, the market updates its beliefs on the basis of the decision taken. Note that a united front supporting implementation commands a higher reputation than a united front supporting the status quo, as the market knows that in any equilibrium implementation signals a larger degree of signal concurrence than maintaining the status quo (because $p < 0$).

The same line of reasoning applies if information could be manipulated during the meeting. If the project is implemented as a result of member 2 exaggerating, he is not going to say he really had negative information (i.e., information different from member 1). Nor will he claim $m_2 = m^g$ if the project failed to be accepted as this would once again hurt his reputation.

Along similar lines one can show that committee members have an incentive to conceal differences in votes cast. When votes differ, the public infers that the committee members have received conflicting signals, not that they care to different degrees about their reputation. Differences in weights attached to reputation would not lead to differences in votes cast as long as all signals would be the same. Differences in votes cast would damage members' reputations. Consequently, once the committee members know which decision will be taken, they will conceal differences in votes cast.

Proposition 6 *Committee members who care about their reputation show a united front.*

7 Committees of n members

We now analyse committees of more than two members, $i \in I = \{1, ..., n\}$, $n > 2$. It will be useful to introduce some notation and terminology. Let k denote the number of positive signals received by the n members, and let $E[\mu|k]$ denote the expected value of μ conditional on k positive signals. The first–best decision rule equals $X = 1$ if and only if $k \geq k^{FB}$, where the number k^{FB} is such that $p + E[\mu|k] \lesseqgtr 0$ for $k \lesseqgtr k^{FB}$. The total number of positive messages sent is denoted by ω. A voting rule, finally, is characterized by a positive integer f such that $X = 1$ if and only if $|v^g| \geq f$, where $|v^g|$ denotes the number of votes v^g cast by the members.

As a benchmark, we begin by analyzing the case that committee members care to the same degree about their reputations ($\lambda_i = \lambda$ for all $i \in I$). As member i's preferences coincide with those of any other member, information is shared in the communication stage. As a result, the identity of the member reporting, say, m^g, is irrelevant, and voting strategies will depend on the total number of positive messages ω only, $v_i(\omega) = \Pr(v_i = v^g|\omega)$. Furthermore, members' voting strategies coincide. Consequently, the voting rule is immaterial. If, moreover, members' preferences equal those of the public, i.e., $\lambda = 0$, then the voting strategy of any member is such that the first-best decision rule is the equilibrium outcome as $v_i(\omega) = 1$ if and only $\omega \geq k^{FB}$.

Proposition 7 *Suppose a committee consists of n members who care to the same degree λ about their reputations. Then there exists an equilibrium in which information is shared and individual voting strategies coincide. The voting rule is immaterial. If, moreover, $\lambda = 0$, then the voting strategy of any member is such that the first-best decision rule is the equilibrium outcome.*

The determination of the first-best decision rule is a statistical matter. Sah and Stiglitz (1988) show that for a committee of given size, the minimal number k^{FB} of positive signals goes down in p, the a priori quality of the project.[9] With an absolute value of p that is sufficiently small, and n odd, a simple majority of positive signals, $k^{FB} = \frac{1}{2}(n+1)$, is the first-best decision rule.[10] More negative values of p require qualified majorities.

There is an interesting implication if $k^{FB} = \frac{1}{2}(n+1)$ is the first-best decision rule: even if committee members are concerned with their reputation, $\lambda_i > 0$, this concern does not influence voting behaviour as there is no difference in reputation between implementation and status quo, $\widehat{\pi}(X=1) = \widehat{\pi}(X=0)$. To see this, assume there are, say, five members, and $k^{FB} = 3$, such that $k \in \{0,1,2\}$ leads to status quo and $k \in \{3,4,5\}$ leads to implementation. If $k = 0$ or 5, all signals concur (all s^b or all s^g, respectively); if $k = 1$ or 4, four signals are the same, while if $k = 2$ or 3 only three are the same. That is, the average degree of agreement among signals is the same whether a project is implemented or rejected. The decision on the project, then, does not reveal any information about the quality of the members of the committee.

Proposition 8 *Suppose a committee consists of n members, n odd, who may care about their reputations, $\lambda_i \geq 0$ for all $i \in I$. If the first-best decision rule is a simple majority of positive signals, $k^{FB} = \frac{1}{2}(n+1)$, then, in equilibrium, the ex post reputations of implementation and status quo are equal, $\widehat{\pi}(X=1) = \widehat{\pi}(X=0) = \pi$. Reputational concerns do not influence the individual voting strategies. Nor will information be manipulated. That is, information is shared, individual voting strategies coincide and are such that the first-best decision rule is the equilibrium outcome.*

[9] To be precise, k^{FB} is a non-increasing function of p as k^{FB} is integer-valued.

[10] Sah and Stiglitz also show that the larger is the committee, the smaller the absolute value of p must be for simple majority rule to be optimal.

In what follows we limit attention to $k^{FB} > \frac{1}{2}(n+1)$, implying that $p < 0$. Moreover, as the decision to implement now implies a higher degree of similarity among signals than the decision to maintain the status quo, we have that $\widehat{\pi}(X=1) > \widehat{\pi}(X=0)$. We assume that members are concerned with their reputations, $0 < \lambda_1 < ... < \lambda_j < ... < \lambda_n$.[11]

7.1 Information cannot be manipulated

Because the interests of the members differ from those of the public, individual voting strategies may not yield the first-best decision rule as the equilibrium outcome. As observed in section 6, by imposing unanimity, the vote of the member whose preferences resemble those of the public most, the public's ally, is decisive in case of a conflict among the members of the committee. Imposing unanimity ensures that the decision to implement the project or not is delegated to member 1, while the information used in the decision is obtained from n members. This is clearly best from the public's perspective.

Proposition 9 *If committee members agree on the a priori value of the project $p < 0$, but care to different degrees about their reputation, and if information cannot be manipulated, the voting rule that promotes the public's interests best is unanimity rule, $f = n$.*

In this subsection we therefore assume that the voting rule is unanimity rule. As information cannot be manipulated, a voting strategy will be written as $v_i(\omega) = \Pr(v_i = v^g|\omega)$. Let ω_1 denote a threshold value of member 1 such that $v_1(\omega) = 1$ if and only if $\omega \geq \omega_1$. If member 1 cares little about his reputation, his equilibrium voting strategy is such that the first-best decision rule is the equilibrium outcome, i.e., $v_1(\omega) = 1$ if and only if $\omega \geq \omega_1^*$, with $\omega_1^* = k^{FB}$. If he cares considerably about his reputation, a project will sometimes be implemented even though its expected value is negative, $\omega_1^* < k^{FB}$. There is, however, a limit to the degree to which member 1 distorts the implementation decision. As in equilibrium $\widehat{\pi}(X=1) > \widehat{\pi}(X=0)$ must hold, implementation should, on average, be based on a smaller

[11] We exclude the possibility $\lambda_i = \lambda_{i'}$ as it is notationally burdensome but does not provide any additional insight.

number of conflicting signals than maintaining the status quo. This implies that implementation should be based on at least a majority of positive signals.

Proposition 10 describes the equilibrium. Part (i) is the n-member equivalent of Proposition 1, whereas part (ii) shows how Proposition 2 generalises. The equilibrium posterior beliefs $\widehat{\pi}(X = x)$ for $x \in \{0, 1\}$ are obtained using Bayes' rule and the equilibrium strategies

Proposition 10 *Suppose information cannot be manipulated in a committee of n members. Suppose the voting rule is unanimity rule.*
(i) If member 1 cares little about his reputation,

$$\lambda_1 \leq \overline{\lambda} := \frac{-\left(p + \mathsf{E}\left[\mu | k^{FB} - 1\right]\right)}{\widehat{\pi}(X = 1) - \widehat{\pi}(X = 0)}, \tag{7}$$

then there is an equilibrium in which member 1's voting strategy equals $v_1(\omega) = 1$ if and only if $\omega \geq \omega_1^* = k^{FB}$. A weakly dominant voting strategy for the other members is $v_i(\omega) = 1$ if and only if $\omega \geq k^{FB}$. The first-best decision rule is the equilibrium outcome.
(ii) If $\lambda_1 > \overline{\lambda}$, then one of the following holds.
(ii–a) There is an equilibrium in which member 1's voting strategy equals $v_1(\omega) = 1$ if and only if $\omega \geq \omega_1^*$, with $\omega_1^* < k^{FB}$ and

$$p + \mathsf{E}\left[\mu | \omega_1^*\right] + \lambda_1 \widehat{\pi}(X = 1) > \lambda_1 \widehat{\pi}(X = 0) \tag{8}$$

$$p + \mathsf{E}\left[\mu | \omega_1^* - 1\right] + \lambda_1 \widehat{\pi}(X = 1) < \lambda_1 \widehat{\pi}(X = 0) \tag{9}$$

Moreover, a weakly dominant voting strategy for the other members is $v_i(\omega) = 1$ if and only if $\omega \geq \omega_1^*$.[12]
(ii–b) There is an equilibrium in which member 1's voting strategy equals $v_1(\omega) = 1$ if $\omega \geq \omega_1^*$; $v_1(\omega_1^* - 1) = \beta_1^* \in (0, 1)$; and $v_1(\omega) = 0$ if $\omega < \omega_1^* - 1$, where (ω_1^*, β_1^*) satisfies[13]

$$p + \mathsf{E}\left[\mu | \omega_1^* - 1\right] + \lambda_1 \widehat{\pi}(X = 1) = \lambda_1 \widehat{\pi}(X = 0) \tag{10}$$

[12] *Furthermore, in equilibrium we have $\omega_i^* \in \left\{\underline{\omega}, ..., k^{FB} - 1\right\}$, where, if n is even, $\underline{\omega} = \frac{1}{2}n + 1$, whereas in case of n odd, $\underline{\omega} = \frac{1}{2}(n + 3)$. This implies that in equilibrium implementation still yields a higher reputation than maintaining the status quo.*

[13] *Of course, $\widehat{\pi}(X = x)$ depend on (ω_1^*, β_1^*).*

A weakly dominant voting strategy for the other members is $v_i(\omega) = 1$ if and only if $\omega \geq \omega_1^*$.[14]

Eq (9) says that for given posterior beliefs $\widehat{\pi}(X = 1)$ and $\widehat{\pi}(X = 0)$ consistent with ω_1^*, member 1 would not like to see the project implemented in case of one positive message less, $\omega_1^* - 1$. He therefore does not mix in case of $\omega = \omega_1^* - 1$. In case (ii–b), the situation is different. Now for given beliefs $\widehat{\pi}(X = 1)$ and $\widehat{\pi}(X = 0)$ consistent with ω_1^*, member 1 would like to implement if $\omega = \omega_1^* - 1$. But if the posterior beliefs were based on him implementing with probability one for $\omega_1^* - 1$, then he would like to refrain from implementing if $\omega = \omega_1^* - 1$. As a result, there is a value $\beta_1^* \in (0, 1)$ such that $v_1(\omega_1^* - 1) = \beta_1^*$, where (ω_1^*, β_1^*) is characterized by Eq (10).

7.2 Information can be manipulated

As members differ in the weights they attach to their reputations, a member $i > 1$ may want to see the project implemented although member 1 chooses the status quo. Consider Proposition 10, part (i) and (iia). If member 1 votes favourably only if $\omega \geq \omega_1^*$, then, for given posterior beliefs, member n would have liked to see the project implemented in case of $\omega_1^* - 1$ (or even fewer) positive signals if the following condition holds:

$$\lambda_n > \underline{\lambda} := \frac{-(p + \mathsf{E}[\mu|\omega_1^* - 1])}{\widehat{\pi}(X = 1) - \widehat{\pi}(X = 0)} \tag{11}$$

Member n has an incentive to exaggerate in the communication stage, and possibly other members have. Analogously, one can derive the condition such that member n wants to exaggerate in case member 1 follows a mixed voting strategy when information cannot be manipulated (cf Proposition 10, part (iib)). This condition can be found in the Appendix (Condition A.1). In this subsection we assume that at least member n wants to manipulate information.

Assumption 2 *The value of λ_n is such that member n wants to manipulate information.*

[14] *Furthermore, in equilibrium $\omega_1^* \in \{\underline{\omega}, ..., k^{FB}\}$ holds, where, if n is even, $\underline{\omega} = \frac{1}{2}n + 1$ and $\beta_1^* < \frac{1}{2}$, whereas in case of n odd, $\underline{\omega} = \frac{1}{2}(n + 3)$ and $\beta_1^* < 1$.*

We now determine what an equilibrium looks like in this situation. We first continue assuming that the voting rule is unanimity rule and then turn to other majority rules. We close this section with a number of examples that show how the choice of voting rule influences the quality of information exchange in the communication stage and the alignment of the decisive member's interests with those of the public.

Unanimity Rule

As far as the transmission of private information is concerned, all members fall into one of the three following sets, I^S, I^E, and I^+. The set I^S consists of members $i > 1$ who attach a weight to their reputation λ_i that is sufficiently close to λ_1 such that i is not frustrated by 1's behaviour in the voting stage. A member $i \in I^S$ has therefore no reason to manipulate information, and shares information in the communication stage. As $1 \in I^S$, this set is non-empty. Let $i = \overline{\sigma}$ denote the member with the highest weight λ_i who is part of I^S, $I^S = \{1, \ldots, \overline{\sigma}\}$. Because of Assumption 2, we know that $\overline{\sigma} < n$ (or $I^S \subset I$).

The set I^E consists either of one member h or is empty. If it is non–empty in equilibrium, it consists of a member who is frustrated by 1's voting behaviour as λ_h differs too much from λ_1. He therefore exaggerates with some probability $\gamma_h := m_h\left(s^b\right) \in (0, 1)$. This implies that, for given voting strategies, h is indifferent between reporting m^g and m^b conditional on $s_h = s^b$ and on his message being pivotal. Recall that this means that by sending m^g the project is implemented, whereas by sending m^b the status quo is maintained. Hence, for $s_h = s^b$, the increase in h's reputation is exactly offset by the loss made on the project.

Any member who cares more about his reputation than h, when contemplating whether to manipulate information or not, has a strict preference for exaggeration: $m_i\left(s^b\right) = 1$. Any such member is part of I^+. As a consequence, information provided by members $i \in I^+$ is useless and therefore ignored in the decision whether to implement the project or not. The set I^+ may be empty. Because of Condition 2, we know that at least member n exaggerates, and so I^E and I^+ cannot both be empty.

It could be that the set of members I^+ exaggerating information is so large that member 1 would not be willing to implement the project even if all members

$i \in I^S$ send positive messages. Consider the extreme situation $I^S = \{1\}$, $h = 2$, and $I^+ = \{3, ..., n\}$, with member h caring so much about his reputation that $\gamma_h^* \to 1$. Essentially, we are back in the situation described in section 5. There we derived that a sufficient condition for an equilibrium to exist in which a project is sometimes implemented is that member 1 is willing to follow his signal when he decides in isolation. That is, $p + \pi u > 0$ should hold. Clearly, if some members $2, ..., n$ care less about their reputation, such that $\gamma_h^* < 1$ or $h > 2$, there will always be sufficiently many and/or sufficiently informative messages inducing member 1 to implement the project as long as $p + \pi u > 0$ holds. If instead $p + \pi u \leq 0$, such may not be the case, and $v_i = v^b$ for $i \in I^S$ and in particular for $i = 1$, irrespective of the messages sent.

Lemma 1 *Suppose information can be manipulated in a committee of n members and suppose Assumption 2 holds. Suppose the voting rule is unanimity rule. A sufficient condition for an equilibrium to exist in which a project is sometimes implemented is that member 1 follows his signal when he decides in isolation, i.e., $p + \pi u > 0$ hold. If instead $p + \pi u \leq 0$ an equilibrium in which a project is implemented may not exist.*

In determining the value of the project, the number ω of positive messages per se is no longer relevant as $n - 1 - \overline{\sigma}$ messages are useless and the message sent by h is manipulated. Let $\omega\left(I^S\right)$ denote the number of positive messages $m_i = m^g$ sent by committee members in set I^S. Let $\omega_1\left(I^S\right)$ be the minimum number of positive messages sent by members of I^S that member 1 requires to vote $v_1 = v^g$ with probability one. Voting strategies amount to $v_i\left(\omega\left(I^S\right), m_h\right) = \Pr\left(v_i = v^g | \omega\left(I^S\right), m_h\right)$, indicating that the voting strategy will depend on the number of positive messages sent by members of I^S and on the message sent by member h.

To spare the reader the mathematical details, the following proposition summarises the characterization of an equilibrium in case of unanimity. The companion proposition A.1 in the Appendix provides the details.

Proposition 11 *Suppose information can be manipulated in a committee of n members. Suppose the voting rule is unanimity rule, $f = n$, suppose Assumption 2 holds and assume $p + \pi u > 0$. An equilibrium is characterized by a group of members*

$I^S = \{1, \ldots, \overline{\sigma}^*\}$ *who share information; and members* $i > \overline{\sigma}^*$ *who exaggerate. The latter group may consist of a member* h *who exaggerates with probability* $\gamma_h^* < 1$, *or of members who exaggerate with probability one, or of both. As member 1's vote is decisive, the difference in degree to which he cares about his repuation and other members do determines the number and identity of members sharing information.*

To show that there does not need to be a member who exaggerates with a probability $\gamma_h^* < 1$, consider a three–member committee in which members 1 and 2 care to approximately the same small degree about their reputation, whereas member 3 cares considerably about his reputation, $0 \lesssim \lambda_1 \lesssim \lambda_2 \ll \lambda_3$. Member 3 always sends message $m_3 = m^g$, and is therefore ignored. The committee becomes essentially a two–member committee, and the analysis of section 5 applies: as long as λ_2 is not too large, member 2 shares his private information.

Other Majority Rules

So far, we have assumed unanimity rule. This is, however, not necessarily the voting rule most desirable from the public's perspective. We first characterize equilibrium committee behaviour in case of other majority rules, and then provide a number of examples showing what makes one rule rather than another preferable.

Assume a majority rule, $f < n$, and let $d = n + 1 - f$ be the member whose vote is decisive: if he votes favourably, then so do members $i > d$, implying that the project is implemented. If he votes against, then so do members $i < d$, implying that the required majority is not attained and the status quo is maintained. Members with interests sufficiently similar to those of member d share their information. This set is $I^S = \{\underline{\sigma}, \ldots, d, \ldots, \overline{\sigma}\}$. It is non-empty as $d \in I^S$. As in case of unanimity, there may be committee members who exaggerate with probability one, $i \in I^+$, or with some probability γ_h less than one, $i = h$. However, there may now also be members $i < d$ who would have conditioned implementation on a larger minimal number of positive messages than member d requires. There may therefore be a set of members, I^-, such that any member $i \in I^-$ underreports with probability one ($m_i = m^b$ if $s_i = s^g$). In equilibrium, these messages are ignored. Analogous to the existence of a member h, there may now be a member l characterized by a probability of underreporting $\gamma_l = \Pr\left(m_l = m^b | s_l = s^g\right) \in (0, 1)$. Analogous to the voting strategies in case of unanimity, voting strategies can now be written as $v_i\left(\omega\left(I^S\right), m_l, m_h\right)$. As under unanimity, as long as member d is willing to follow his signal when he decides in isolation, an equilibrium exists in which a project is sometimes implemented. This requires $p+\pi u > 0$. If $p+\pi u \leq 0$, such an equilibrium may exist. Otherwise, $v_d = 0$ and $X = 0$ in equilibrium.

The following proposition summarises the characterization of an equilibrium in case of majority. The companion proposition A.2 in the Appendix provides the details.

Proposition 12 *Consider a committee of n members using a majority rule f, implying that member $d = n + 1 - f$ is decisive. Assume information can be manipulated. Suppose Assumption 2 holds and assume $p + \pi u > 0$. An equilibrium is characterized by a group of members $I^S = \{\underline{\sigma}^*, \ldots, d, \ldots, \overline{\sigma}^*\}$ who share information; members $i > \overline{\sigma}^*$ who exaggerate; and members $i < \underline{\sigma}^*$ who underreport. The first group may consist of a member h who exaggerates with probability $\gamma_h^* < 1$, or of members who exaggerate with probability one, or of both. The latter group may consist of a member h who exaggerates with probability $\gamma_h^* < 1$, or of members who exaggerate with probability one, or of both. As member d's vote is decisive, the difference in degree to which he cares about his repuation and other members do determines the number and identity of members sharing information.*

Comparing Unanimity and Other Majority Rules

That unanimity is not necessarily the socially desirable voting rule if information can be manipulated can be illustrated by means of the following example. Consider a five–member committee in which member 1 and 2 care little about their reputations, but the other three members considerably and to roughly the same degree, $0 \lesssim \lambda_1 \lesssim \lambda_2 \ll \lambda_3 \lesssim \lambda_4 \lesssim \lambda_5$. In case of unanimity as the voting rule, member 3, 4 and 5 all exaggerate with probability one. The implementation decision is then based on information held by member 1 and 2. If, instead, the voting rule is a majority of three, member 1 and 2 would manipulate their information (they would underreport with probability one), and members 3, 4, and 5 would share their private information. The implementation decision would now depend on three pieces of truthfully revealed information. Therefore, if the voting rule makes member 3 (or 4 or 5) decisive the decision on the project is based on more information than if the voting rule makes member 1 (or 2) decisive. However, because member 3 cares much about his reputation, he has too strong an incentive to implement the project. Hence, in the present example the public faces a trade-off when choosing the optimal voting rule. By making member 1 decisive the public ensures that given the available information the optimal decision is made. By making member 3 decisive, the decision might be distorted but it is based on more information.

This example also suggests that replacing a member with someone who cares less about his reputation may lead to a worse outcome from the public's perspective. Consider, e.g., a committee of five members, consisting of a fairly homogenous group of size four and one member whose preferences are more closely aligned with those of the public, $0 \lesssim \lambda_1 \ll \lambda_2 \lesssim \lambda_3 \lesssim \lambda_4 \lesssim \lambda_5$, such that a majority rule with $f = 4$ is best. If one member of the homogenous group is replaced by someone with $\lambda \gtrsim 0$, a majority rule with $f = 3$ is best. The only consequence of this replacement is then to eliminate valuable information from the decision–making process.

Note that in a situation where $0 \lesssim \lambda_1 \lesssim \lambda_2 \lesssim \lambda_3 \ll \lambda_4 \lesssim \lambda_5$ unanimity is the optimal voting rule. The decision will be based on more pieces of information (three rather than two) and will not be distorted.

7.3 What have we learnt from our model of a committee with n members?

We have derived three kinds of results. The first result is that our main findings of the model of a committee with 2 members also hold for a committee with n members. Thus, the tendency of committee members to speak with one voice is independent of the size of the committee. Moreover, as in a committee with 2 members, in a committee with n members, reputational concerns may lead some members to exaggerate the benefits of projects. As to the latter finding, it is worth noting that in a committee with n members, some members may *always* exaggerate benefits, while in a committee with 2 members benefits are *sometimes* exaggerated.

Second, our analysis offers a new insight into the question on the optimal voting rule. The voting rule determines the identity of the member who is decisive in the voting stage and the quality of information exchange in the communication stage.

The analysis of the model of a committee with 2 members shows that it makes sense to make the member who cares the least about his reputation decisive. This member has the weakest incentive to distort the implementation decision as his preferences are closest to the public's preferences. The equilibria of the model of a committee with n members show that with a view on utilizing members' privately held information, it may be that another member should be made decisive. The reason is that as to manipulation of information what matters is how much members' preferences deviate from the preferences of the decisive member. In a committee in which member 1 is an outlier and a homogeneous group of members with similar preferences exists, it is possibly optimal to make a member of the group decisive. This may lead to better informed decisions. Of course, if information cannot be manipulated, unanimity remains the best voting rule.

Our third result is related to the second one. It is possible that it is not in the interest of the public to replace a member of the committee with a member whose preferences are more congruent with the preferences of the public. The reason is that an ally of the public may have too strong incentives to manipulate information. As a result his information will be ignored.

8 Concluding remarks

It seems quite likely that experts on committees care much about how people perceive their abilities. We have shown that much of the behaviour of committee members can be explained by reputational concerns. Examples of such behaviour are the tendency of committees to close ranks in public, and the inclination of some committee members to exaggerate the benefits of a proposal or to suppress their personal doubts.

We are aware that our results hinge on several specific assumptions. We end this paper by elaborating on three of them. First, we have focused on the situation in which a committee member is concerned with his perceived ability. As a result, committees want to speak with one voice. Other types of reputation may be at stake, making speaking with one voice less desirable. A committee member may want to show that he is an independent thinker, holding views about the correct decision different from those of the winning majority. An example could be an academic advisor on an advisory committee. Alternatively, if a committee member represents a group, like an organizational division, he may want to reveal that he voted in line with the agreed upon group mandate, even if he did not have his way in the committee meeting. Such considerations may explain part of the observed dissenting votes at the FOMC.[15]

Second, we have assumed that the ex ante expected value of the project is negative. As a result, implementing the project is good for one's reputation. Clearly, with a positive ex ante expected value, maintaining the status quo would have strengthened a member's reputation. In either case, if information cannot be manipulated, it is best from a social point of view to delegate the implementation decision to the member who is least concerned with his reputation. If instead information can be manipulated a balance has to be struck between information exchange in the meeting on the one hand, and putting the actual decision power in the hands of the member most inclined to decide in line with the public's interests.

Finally, we have assumed that the public observes the decision on the project, but does not observe outcomes. At the expense of more algebra, but without affecting our results qualitatively, we could have assumed that the public observes outcomes, but that there are unpredictable factors affecting outcomes that neither smart committee members nor dumb committee members observe. The larger is the unpredictable part of outcomes, the stronger are the reputational effects on the behaviour of the committee members.

9 References

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[15] See Havrilesky and Schweitzer (1990) and references therein for econometric analysis relating the likelihood of dissent voting to individual characteristics (and in particular to 'distance' from the central government).

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Appendix

The appendix presents the proofs of propositions 1, 2, and 4. Next we present Condition A.1 that rules when member n wants to manipulate information if member 1 follows a mixed equilibrium voting strategy. Finally we present the 'companion' propositions describing equilibrium behaviour if information can be manipulated in an $n-$member committee, 11 and A.2.

Proof of Proposition 1: We first show that the posterior beliefs are consistent with the imputed equilibrium strategies. $\widehat{\pi}(X=1) = \Pr(t_i = sm|X=1)$ To use Bayes' rule we need expressions like

$$\begin{aligned}\Pr(X=1|t_i=sm) &= \Pr(\mu=u)\Pr(X=1|t_i=sm,\mu=u) \\ &\quad +\Pr(\mu=-u)\Pr(X=1|t_i=sm,\mu=-u)\end{aligned}$$

where, because of the imputed strategy, $X=1$ iff $s_1=s_2=s^g$. So,

$$\Pr(X=1|t_i=sm,\mu=u) = \Pr(s_1=s_2=s^g|t_i=sm,\mu=u) = \pi+(1-\pi)\frac{1}{2} = \frac{1}{2}(1+\pi)$$

Similarly, $\Pr(X=1|t_i=sm,\mu=-u) = 0$ (as $X=1$ requires at least $s_i=s^g$, but $\mu=-u$ and $t_i=sm$ implies that $s_i=s^b$). Therefore, $\Pr(X=1|t_i=sm) = \frac{1}{4}(1+\pi)$. Similar calculations show that $\Pr(X=1|t_i=du) = \frac{1}{4}$. From this it follows that $\Pr(X=0|t_i=sm) = \frac{1}{4}(3-\pi)$ and $\Pr(X=0|t_i=du) = \frac{3}{4}$. Using Bayes' rule, $\widehat{\pi}(X=1) = \frac{1+\pi}{1+\pi^2}\pi$ and $\widehat{\pi}(X=0) = \frac{3-\pi}{3-\pi^2}\pi$ follow immediately.

We now show that for given posterior beliefs the strategies are equilibrium strategies if and only if $\lambda_1 \leq \overline{\lambda}$. In case of $s_1=s_2=s^g$, $X=1$ is preferred to $X=0$ by both members, because implementation is best from a project perspective and from a reputational point of view (see assumption 1 and observe that $\widehat{\pi}(X=1) > \widehat{\pi}(X=0)$). In case of $s_1 \neq s_2$, $\mathsf{E}[\mu|s_1 \neq s_2] = 0$, and member i favours maintaining the status quo if $p + 0 + \lambda_i\widehat{\pi}(X=1) \leq \lambda_i\widehat{\pi}(X=0)$ or if $\lambda_i \leq \overline{\lambda} := \frac{-p}{\widehat{\pi}(X=1)-\widehat{\pi}(X=0)}$. As implementation requires unanimity, the status quo is maintained if $\lambda_1 \leq \overline{\lambda}$. Clearly, if member 1 refrains from voting favourably in case of two conflicting signals, so he does in case of $s_1=s_2=s^b$. If instead $\lambda_1 > \overline{\lambda}$, both members 1 and 2 want to implement the project in case of conflicting signals, and the posterior beliefs $\widehat{\pi}(X=1)$ and $\widehat{\pi}(X=0)$ cannot be equilibrium beliefs. QED.

Proof of Proposition 2: The proof follows from the analysis provided in the text.

Here we limit ourselves to deriving the posterior beliefs stated in Eq (3). Note that

$$\begin{aligned}
\Pr(X=1|t_1=sm,\mu=u) &= \frac{1+\pi}{2}+\frac{1-\pi}{2}\beta_1 \\
\Pr(X=1|t_1=sm,\mu=-u) &= \frac{1-\pi}{2}\beta_1 \\
\Pr(X=1|t_1=du,\mu=u) &= \frac{1+\pi}{2}\left(\frac{1}{2}+\frac{1}{2}\beta_1\right)+\frac{1-\pi}{2}\frac{1}{2}\beta_1 \\
\Pr(X=1|t_1=du,\mu=-u) &= \frac{1-\pi}{2}\left(\frac{1}{2}+\frac{1}{2}\beta_1\right)+\frac{1+\pi}{2}\frac{1}{2}\beta_1
\end{aligned}$$

and so

$$\begin{aligned}
\Pr(X=1|t_1=sm) &= \frac{1}{4}\left(1+\pi+2(1-\pi)\beta_1\right) \\
\Pr(X=1|t_1=du) &= \frac{1}{4}\left(1+2\beta_1\right)
\end{aligned}$$

from which $\widehat{\pi}(X=1;\beta_1)=\frac{(1+\pi)+2(1-\pi)\beta_1}{(1+\pi^2)+(1-\pi^2)\beta_1}\pi$ immediately follows using Bayes' rule. The fact that we conditioned the probabilities on the type of member 1 is immaterial as can be readily checked. Using $\Pr(X=0|t_1)=1-\Pr(X=1|t_1)$ one finds that $\widehat{\pi}(X=0;\beta_1)=\frac{3-\pi-2(1-\pi)\beta_1}{3-\pi^2-2(1-\pi^2)\beta_1}\pi$. QED

Proof of Proposition 4: In the text we showed that in case information cannot be manipulated, unanimity rule is best. Here we show that if information can be manipulated, and the committee consists of two members, the voting rule is immaterial.

In section 5 we have shown that if $\lambda_2<\overline{\lambda}$, neither member wants to deviate from the first–best decision rule, and so unanimity and simple majority perform equally well.

Now assume $\lambda_2>\overline{\lambda}$. In case of unanimity, Eq (6) specifies the probability γ_2^* with which member 2 states $m_2=m^g$ if $s_2=s^b$. A project is implemented only if both members are positive during the meeting, $m_1=m_2=m^g$. As a result, a project is implemented with probability one if $(s_1,s_2)=(s^g,s^g)$, with probability $\gamma_2^*<1$ if $(s_1,s_2)=\left(s^g,s^b\right)$, and with probability zero if $(s_1,s_2)=\left\{\left(s^b,s^g\right),\left(s^b,s^b\right)\right\}$.

If instead a single positive vote suffices for project implementation, member 2 does not have to manipulate his information, as he can now force implementation by voting $v_2=v^g$. Now either member 1 wants to manipulate his private information or not. Suppose not. Then, member 2 implements the project if $(s_1,s_2)=(s^g,s^g)$

with probability one, and, if $(s_1, s_2) = \left\{\left(s^b, s^g\right), \left(s^g, s^b\right)\right\}$ with probability β_2^*, where $\beta_2^* = \frac{1}{2}\gamma_2^*$. That is, the probability with which a project is implemented and the expected value conditional on implementation is the same under either voting rule.

Now suppose member 1 wants to manipulate information. Because he cares less about his reputation he wants to understate his information. Define $\gamma_1 = \Pr\left(m_1 = m^b | s_1 = s^g\right)$ and let $\gamma_1 > 0$. As a result,

$$\mathsf{E}\left(\mu | m_1 = m^b, m_2 = m^g\right) > \mathsf{E}\left(\mu | m_1 = m^g, m_2 = m^b\right) \tag{A.1}$$

Member 2 may vote favourably in case of $(m_1, m_2) = (m^g, m^g)$, and with some probability in case of $(m_1, m_2) = \left(m^b, m^g\right)$. This probability is smalller than one, because if he were to vote $v_2 = v^g$ with probability one, the overall likelihood of implementation would be equal to the total probability of maintaining the status quo, and, consequentially, the ex post reputation in case of implementation would be the same as in case of maintaining the status quo. So, let $\beta_2 = \Pr\left(v_2 = v^g | m_1 = m^b, m_2 = m^g\right) < 1$, then $\Pr\left(v_2 = v^g | m_1 = m^g, m_2 = m^b\right) = 0$ because of Eq (A.1). But then member 1's message is only pivotal in case $m_2 = m^g$ (and so $s_2 = s^g$). Underreporting yields member 1

$$\begin{aligned}&\Pr(s_2 = s^g | s_1 = s^g)\left(\beta_2\left[p + \mathsf{E}(\mu | s_1 = s^g, s_2 = s^g) + \lambda_1 \widehat{\pi}(X = 1; \gamma_1, \beta_2)\right] + \right.\\&\left.(1 - \beta_2)\lambda_1 \widehat{\pi}(X = 0; \gamma_1, \beta_2)\right)\end{aligned}$$

whereas the payoff in case of truthfully revealing his positive information equals

$$\Pr(s_2 = s^g | s_1 = s^g)\left[p + \mathsf{E}(\mu | s_1 = s^g, s_2 = s^g) + \lambda_1 \widehat{\pi}(X = 1; \gamma_1, \beta_2)\right]$$

Clearly, since in any equilibrium $\widehat{\pi}(X = 1; \gamma_1, \beta_2) > \widehat{\pi}(X = 0; \gamma_1, \beta_2)$ and because $p + \mathsf{E}(\mu | s_1 = s^g, s_2 = s^g) > 0$ by Assumption 1, member 1 has a strict preference for truthfully revealing his positive information. That is, even if he could, member 1 would not manipulate his information. As a result, in a two–member committee in which information can be manipulated the voting rule is immaterial. QED.

Statement of condition A.1.We here provide the condition that guarantees that if member 1 follows a mixed equilibrium voting strategy if information cannot be manipulated, member n wants to exaggerate if information *can* be manipulated.

Note that if member 1 follows a mixed equilibrium voting strategy, member n's message is pivotal in two situations: if $\omega = \omega_1^* - 2$ and if $\omega = \omega_1^* - 1$. In the first case, exaggeration increases the probability of implementation from 0 to β_1^*. In the second case, it increases the probability of implementation from β_1^* to 1.

Condition A.1 *Suppose member 1 follows the mixed equilibrium voting strategy specified in Proposition 10 part (ii), if information cannot be manipulated. Then member n would like to manipulate information if the following inequality holds*

$$\begin{aligned}
&\Pr\left(\omega = \omega_1^* - 2 | s^b\right) \beta_1^* \times \\
&\left(p + \mathsf{E}\left[\mu | \omega_1^* - 2\right] + \lambda_n \left[\widehat{\pi}\left(X = 1\right) - \widehat{\pi}\left(X = 0\right)\right]\right) + \\
&\Pr\left(\omega = \omega_1^* - 1 | s^b\right) \left(1 - \beta_1^*\right) \times \\
&\left(p + \mathsf{E}\left[\mu | \omega_1^* - 1\right] + \lambda_n \left[\widehat{\pi}\left(X = 1\right) - \widehat{\pi}\left(X = 0\right)\right]\right) > 0
\end{aligned} \tag{A.2}$$

Companion to Proposition 11: Here we characterize the equilibrium in case information can be manipulated and under unanimity rule in more detail. Different types of equilibria exist, depending on whether member 1 uses a mixed or pure equilibrium voting strategy and on whether a member exists who exaggerates with a probability, (i.e., whether set I^E is a singleton or empty). As presenting all four cases does not add economic intuition, we only characterize an equilibrium in case member 1 uses a mixed equilibrium voting strategy and I^E is non-empty. In the proposition $E\left[\mu | x, z_h\right]$ denotes the expected value of μ conditional on x positive messages sent by members $i \in I^S$ and message or signal z of member h.

Proposition A.1 *Suppose information can be manipulated in a committee of n members. Suppose the voting rule is unanimity rule, $f = n$, suppose Assumption 2 holds and assume $p + \pi u > 0$. An equilibrium is described by the quadruple $\left(\omega_1^*\left(I^S\right), \beta_1^*, \overline{\sigma}^*, \gamma_h^*\right)$, with $\overline{\sigma}^* < n$. Member $i \in I^S = \{1, \ldots, \overline{\sigma}^*\}$ shares information; member h (with $h = \overline{\sigma}^* + 1$) exaggerates with probability $\gamma_h^* \in (0,1)$; any member $i \in I^+ = \{\overline{\sigma}^* + 2, \ldots, n\}$ exaggerates with probability one. Member 1 votes*

$$v_1\left(\omega\left(I^S\right), m_h\right) = \begin{cases} 1 & \textit{for } \omega\left(I^S\right) \geq \omega_1^*\left(I^S\right) \\ \beta_1^* & \textit{for } \left(\omega\left(I^S\right), m_h\right) = \left(\omega_1^*\left(I^S\right) - 1, m^g\right) \\ 0 & \textit{for } \left(\omega\left(I^S\right), m_h\right) = \left(\omega_1^*\left(I^S\right) - 1, m^b\right) \\ 0 & \textit{for } \omega\left(I^S\right) \leq \omega_1^*\left(I^S\right) - 2 \end{cases}$$

with $\beta_1^* \in (0,1)$. A weakly dominant strategy for $i > 1$ is $v_i\left(\omega\left(I^S\right), m_h\right) = 1$ if and only if $\omega\left(I^S\right) \geq \omega_1^*\left(I^S\right) - 1$. The quadruple $\left(\omega_1^*\left(I^S\right), \beta_1^*, \overline{\sigma}^*, \gamma_h^*\right)$ satisfies

$$p + \mathsf{E}\left[\mu|\omega_1^*\left(I^S\right) - 1, m^g\right] + \lambda_1 \widehat{\pi}\left(X = 1\right) = \lambda_1 \widehat{\pi}\left(X = 0\right) \tag{A.3}$$

$$p + \mathsf{E}\left[\mu|\omega_1^*\left(I^S\right) - 1, s^b\right] + \lambda_h \widehat{\pi}\left(X = 1\right) = \lambda_h \widehat{\pi}\left(X = 0\right) \tag{A.4}$$

with $\widehat{\pi}\left(X = x\right) = \widehat{\pi}\left(X = x; \omega_1^*\left(I^S\right), \beta_1^*, \gamma_h^*\right)$ for $x \in \{0,1\}$ obtained using Bayes' rule.

Because h follows a mixed messaging strategy, positive messages may now contain different information on μ. Eq (A.3) says that member 1 is indifferent between v^g and v^b if $\omega\left(I^S\right) = \omega_1^*\left(I^S\right) - 1$ and $m_h = m^g$. As a consequence, 1 has a strict preference for $v_1 = v^g$ ($v_1 = v^b$) if the messages sent in the communication stage contain more (less) positive information. It implies that $v_1 = v^b$ with probability one if (i) $\omega\left(I^S\right) = \omega_1^*\left(I^S\right) - 1$ and $m_h = m^b$; and (ii) $\omega\left(I^S\right) = \omega_1^*\left(I^S\right) - 2$, irrespective of m_h. It also implies that $v_1 = v^g$ with probability one if $\omega\left(I^S\right) = \omega_1^*\left(I^S\right)$, irrespective of m_h. Member 1's voting strategy implies that member h's message is pivotal only if $\omega\left(I^S\right) = \omega_1^*\left(I^S\right) - 1$, as is confirmed by (A.4). Eq (A.4) also implies that any member $i \in I^+$ exaggerates with probability one, whereas any member $i \in I^S$ shares information.

Note that it cannot be the case for member 1 to be indifferent between v^g and v^b in case of $\omega\left(I^S\right) = \omega_1^*\left(I^S\right) - 1$ and $m_h = m^b$ (rather than $m_h = m^g$). The message $m_h = m^b$ implies $s_h = s^b$, and so the expected project value in Eqs (A.3) and Eqs (A.4) would be the same. This cannot be reconciled with $\lambda_1 < \lambda_h$.

Companion to Proposition 11: Similarly to the unanimity case, different types of equilibrium may exist depending on whether member d follows a pure or mixed equilibrium voting strategy; on the presence or absence of a member h who exaggerates with a probability smaller than one; and on the presence or absence of a member l who underreports with a probability smaller than one. We only characterize an equilibrium in which member d follows a mixed equilibrium voting strategy and members l and h exist. In the proposition $E\left[\mu|x, y_l, z_h\right]$ denotes the expected value of μ conditional on x positive messages sent by members $i \in I^S$, message or signal y of member l, and message or signal z of member h.

Proposition A.2 *Consider a committee of n members using a majority rule f, implying that member $d = n+1-f$ is decisive. Assume information can be manipulated, and assume that at least either member 1 or n would like to manipulate information. An equilibrium is characterized by a tuple $\left(\omega_d^*\left(I^S\right), \beta_d^*, \underline{\sigma}^*, \overline{\sigma}^*, \gamma_l^*, \gamma_h^*\right)$. Member $i \in I^S = \{\underline{\sigma}^*, \ldots, d, \ldots, \overline{\sigma}^*\}$ shares information; member l (where $l = \underline{\sigma}^* - 1$) underreports with probability $\gamma_l^* \in (0,1)$; member h (where $h = \underline{\sigma}^* + 1$) exaggerates with probability $\gamma_h^* \in (0,1)$; any member $i \in I^- = \{1, \ldots, \underline{\sigma}^* - 2\}$ underreports with probability one; any member $i \in I^+ = \{\overline{\sigma}^* + 2, \ldots, n\}$ exaggerates with probability one. Member d votes*

$$v_d\left(\omega\left(I^S\right), m_l, m_h\right) = \begin{cases} 1 & \text{for } \omega\left(I^S\right) \geq \omega_d^*\left(I^S\right) \\ 1 & \text{for } \left(\omega\left(I^S\right), m_l, m_h\right) = \left(\omega_d^*\left(I^S\right) - 1, m^g, m^g\right) \\ \beta_d^* & \text{for } \left(\omega\left(I^S\right), m_l, m_h\right) = \left(\omega_d^*\left(I^S\right) - 1, m^b, m^g\right) \\ 0 & \text{for } \left(\omega\left(I^S\right), m_l, m_h\right) = \left(\omega_d^*\left(I^S\right) - 1, m^g, m^b\right) \\ 0 & \text{for } \left(\omega\left(I^S\right), m_l, m_h\right) = \left(\omega_d^*\left(I^S\right) - 1, m^b, m^b\right) \\ 0 & \text{for } \omega\left(I^S\right) \leq \omega_d^*\left(I^S\right) - 2 \end{cases}$$

if $\mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, m^g, m^b\right] < \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, m^b, m^g\right]$. If instead

$$\mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, m^g, m^b\right] > \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, m^b, m^g\right]$$

then for $\left(\omega\left(I^S\right), m_l, m_h\right) = \left(\omega_d^*\left(I^S\right) - 1, m^g, m^b\right)$, we have $v_d\left(\omega\left(I^S\right), m_l, m_h\right) = 1$. Of course, $\beta_d^* \in (0,1)$. A weakly dominant voting strategy for $i > \overline{\sigma}^*$ is $v_i\left(\omega\left(I^S\right), m_l, m_h\right) = 1$ if $\omega\left(I^S\right) \geq \omega_d^*\left(I^S\right) - 1$; and a weakly dominant voting strategy for $i < \underline{\sigma}^*$ is $v_i\left(\omega\left(I^S\right), m_l, m_h\right) = 1$ if $\omega\left(I^S\right) \geq \omega_d^*\left(I^S\right)$. The tuple $\left(\omega_d^*\left(I^S\right), \beta_d^*, \underline{\sigma}^*, \overline{\sigma}^*, \gamma_l^*, \gamma_h^*\right)$ satisfies,

$$p + \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, m^b, m^g\right] + \lambda_d \widehat{\pi}(X=1) = \lambda_d \widehat{\pi}(X=0) \tag{A.5}$$
$$p + \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, m^b, s^b\right] + \lambda_h \widehat{\pi}(X=1) = \lambda_h \widehat{\pi}(X=0) \tag{A.6}$$
$$p + \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, s^g, m^g\right] + \lambda_l \widehat{\pi}(X=1) = \lambda_l \widehat{\pi}(X=0) \tag{A.7}$$

where $\widehat{\pi}(X=x) = \widehat{\pi}\left(X=x; \omega_d^*\left(I^S\right), \beta_d^*, \gamma_l^*, \gamma_h^*\right)$.

Most of the statement of the proposition follows from the analysis and characterizations in the main text. Here we pay attention to d's voting strategy.

We first show why an equilibrium in which d follows a mixed voting strategy and l and h mixed communication strategies implies that d can only be indifferent when both l and h send potentially manipulated messages ($(m_l, m_h) = \left(m^b, m^g\right)$). Essentially, this amounts to showing that if d were indifferent for another message combination, either l or h would want to follow a pure equilibrium strategy. Without providing the full details, let us note that a message combination different from $(m_l, m_h) = \left(m^b, m^g\right)$ would automatically imply that either h or l (or both) would be revealing their signal(s). We explicitly analyse one case. Assume d would be indifferent for the message combination $(m_l, m_h) = (m^g, m^g)$. Note, and this is essential, that $m_l = m^g$ reveals that $s_l = s^g$ because member l *underreports* with some likelihood. Hence, for member d the following equality would hold

$$p + \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, s^g, m^g\right] + \lambda_d \widehat{\pi}\left(X = 1\right) = \lambda_d \widehat{\pi}\left(X = 0\right) \tag{A.8}$$

This would imply that if

$$\omega\left(I^S\right) = \omega_d^*\left(I^S\right) - 1 \quad \text{and} \quad (m_l, m_h) \in \left\{\left(m^b, m^g\right), \left(m^g, m^b\right), \left(m^b, m^b\right)\right\}$$

member d would have a strict preference for $v_d = v^b$. Now consider member l, and assume $s_l = s^g$ and that his message is pivotal. Let

$$\theta = \Pr\left(m_h = m^g|\omega\left(I^S\right) = \omega_d^*\left(I^S\right) - 1, s_l = s^g\right)$$

Then, by sending $m_l = m^g$ he obtains

$$\begin{aligned}&\theta\left(\beta_d^*\left(p + \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, s^g, m^g\right] + \lambda_l \widehat{\pi}\left(X = 1\right)\right) + \left(1 - \beta_d^*\right)\lambda_l \widehat{\pi}\left(X = 0\right)\right) + \\ &(1 - \theta)\,\lambda_l \widehat{\pi}\left(X = 0\right)\end{aligned} \tag{A.9}$$

and by sending $m_l = m^b$ his payoff equals

$$\lambda_l \widehat{\pi}\left(X = 0\right) \tag{A.10}$$

If l follows a mixed communication strategy he must be indifferent between sending either message. Equating Eqs (A.9) and (A.10) one sees that the following must hold

$$p + \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, s^g, m^g\right] + \lambda_l \widehat{\pi}\left(X = 1\right) = \lambda_l \widehat{\pi}\left(X = 0\right) \tag{A.11}$$

Note that the expected value of μ in Eqs (A.8) and (A.11) is conditioned on the same information (as $m_l = m^g$ reveals $s_l = s^g$). For both members d and l to follow a mixed strategy in equilibrium, Eqs (A.8) and (A.11) should both be satisfied. This is however impossible as $\lambda_l < \lambda_d$. By the same token it can be shown that as long as at least one message sent by either l or h reveals his signal an equilibrium does not exist in which d, l, and h follow a mixed strategy. It also suggests why members l, d, and h *can* follow a mixed strategy in equilibrium if d is indifferent when both l and h send manipulated messages. This is the only case that the information used in the determination of the expected value of μ differs from one member to the other.

Next, with d indifferent between v^g and v^b when $\omega\left(I^S\right) = \omega_d^*\left(I^S\right) - 1$ and $(m_l, m_h) = \left(m^b, m^g\right)$, whether d votes v^g or v^b in case of $\omega\left(I^S\right) = \omega_d^*\left(I^S\right) - 1$ and $(m_l, m_h) = \left(m^g, m^b\right)$ depends on the sign of $\mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, m^g, m^b\right] - \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, m^b, m^g\right]$. If the sign is positive, he votes v^g, whereas if it is negative he votes v^b. The sign will depend on the degrees to which members l and h manipulate the information they present.

Finally, with d indifferent between v^g and v^b when $\omega\left(I^S\right) = \omega_d^*\left(I^S\right) - 1$ and $(m_l, m_h) = \left(m^b, m^g\right)$, he has a strict preference for v^g in case of $\omega\left(I^S\right) \geq \omega_d^*\left(I^S\right)$, irrespective of the messages sent by l and h. Observe that $\mathsf{E}\left[\mu|\omega_d^*\left(I^S\right), m^b, m_h = m^b\right] > \mathsf{E}\left[\mu|\omega_d^*\left(I^S\right) - 1, m^b, m_h = m^g\right]$, as h exaggerates with positive probability. The loss in value due to absence of a manipulated message from h is more than offset by the gain of one additional positive message sent by some $i \in I^S$. If this inequality holds for $\omega\left(I^S\right) = \omega_d^*\left(I^S\right)$, then it certainly holds for $\omega\left(I^S\right) > \omega_d^*\left(I^S\right)$. Moreover, if it holds for $(m_l, m_h) = \left(m^b, m^b\right)$, then it certainly holds for other combinations of (m_l, m_h). A similar line of reasoning shows that d has a strict preference for v^b in case of $\omega\left(I^S\right) \leq \omega_d^*\left(I^S\right) - 2$, irrespective of the messages sent by l and h. QED.